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DESIGN AND IMPLEMENTATION OF ENERGY EFFICIENT ENVIRONMENT MONITORING SYSTEM

NIKITA GAIKWAD [1], YOGITA MISTRY[2] & KIRAN L.INAMDAR[3]

[1]*me Student, EXTC Department, Phcet, Mumbai, India*

[2]*Assistant Professor, EXTC Department, Phcet, Mumbai, India*

[3]*Assistant Professor, Electrical Department, Phcet, Mumbai, India*

ABSTRACT

This paper presents Energy Efficient Environment monitoring system which monitors the environmental parameter temperature and humidity. Traditionally existing environmental monitoring systems suffers from a problem of power consumption as these systems are powered by batteries. To overcome this limitation, low power consuming real time environment parameter monitoring system is proposed. The proposed system consists of wireless sensor node and backend server. In order to achieve energy efficiency wireless sensor node uses low power consumption 32 bit ARM7 microcontroller and a low power and noise free zigbee communication module with temperature and humidity sensors. The backend server is nothing but a personal computer with graphical user interface (GUI).The wireless sensor node collects the data of all sensors and sends to the backend server via zigbee communication module. Backend server shows the monitoring parameters and finally data is stored in the database server for future analysis.

KEYWORDS: Environment Monitoring, Energy Efficiency, Wireless Sensor Node, Backend Server.

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Original Article

INTRODUCTION

In numerous environmental factors, temperature, humidity is most important parameters in industrial area. In some industries there are some special requirements for it because these are most difficult to control environmental factor. These parameters affect the many manufacturing process in industries. Embedded environment monitoring system plays an important role in industrial area. With the development of modern industry, the requirement for environment monitoring system is increasing day by day. In view of continuously growing demand, the system should have the adaptability and ability to measure the environmental parameter with low power consumption. In recent year, Wireless sensor network plays an important role in environment monitoring system. Basically, environment monitoring system consists of sensor node, co-ordinator with PC. In addition in recent years, energy conservation is one of topic of concern. Existing Environment monitoring systems suffers from a problem of power consumption as the node of Environment monitoring system is powered by batteries. As battery power is limited, it will directly reduce the lifetime of system. Therefore power consumption can be achieved by selecting low power consumption components and applying appropriate design techniques.

REVIEW WORK

Nihal Kulratna et.al [1] presents, a low cost wired environment monitoring system which monitores the concentration of pollutant. The system is based on Smart transducer interface module and NCAP which display all

the measured parameter in the form of GUI. Octavian A.Postolache et.al [2] developed a Wi-Fi based indoor-outdoor environment monitoring system which monitors the environmental parameter temperature, humidity, CO2, methan. In this concept of neural network processing block embedded on sensing nodes for increasing accuracy of measurement and to increase the range of communication.A.R.Al-Ali et.al [3] implemented Long range communication GPRS based environment air quality monitoring system. They also include GPS to provide the information of physical location and time of real time monitoring data. Pollution server with internet connectivity display the data and stored in database. Anuj Kumar et.al [4] discusses various techniques and variation in hardware for implementation of environment monitoring system. It focuses on power consumption and cost of system. But environmental parameter and air quality could not be measured simultaneously.Bortosz Pekoslawski et.al [5] introduced Autonomous greenhouse environment monitoring system which monitors temperature and soil moisture. It uses energy harvesting techniques to provide battery less power supply. A. Kumar et.al [6] presented a IEEE 802.15.4 and IEEE 1451 standard based environment monitoring system for monitoring gases and environmental parameter .In this energy efficient gas sensing modules were developed. Sherin Abraham et.al presented a Cost effective indoor monitoring system [7].The system is based on the Arduino and zigbee communication module.It uses microgas sensor for indoor air quality monitoring.

PRAPOSED SYSTEM

In this paper, Energy efficient environment monitoring system is presented which monitors the environmental parameter temperature and humidity. This system consists of ARM7 microcontroller and Zigbee communication module as these modules have low power consumption. The system consists of Wireless sensor node and Backend server. Sensor node is design with low power consumption ARM7 microcontroller, low cost, low power and noise free zigbee communication module with temperature and humidity sensors. Backend server is a personal computer with graphical user interface. Sensor node collects the data from sensors, process and transmitted to the backend server via Zigbee protocol. Backend server is design with GUI which shows monitoring parameter and finally data is stored in database server.

HARDWARE DESIGN

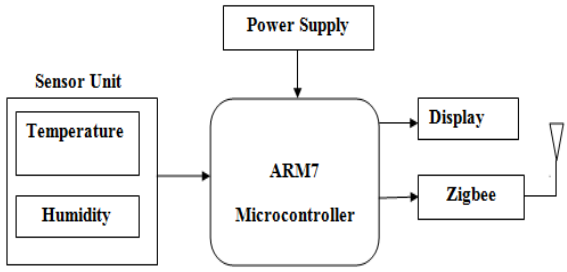

Figure 1: Sensor Node of System

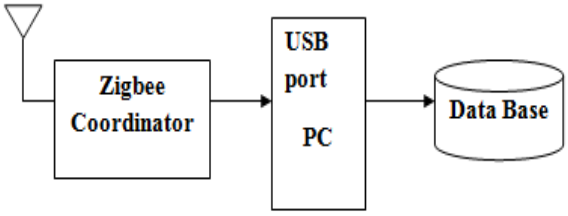

Figure 2: Backend server

- **Design of WSN**

Embedded based wireless sensor node is designed by integrating following hardware modules. As shown in figure WSN consists of 32-bit ARM7 microcontroller, sensor unit and zigbee communication module. Each of these components is described in the following**.**

- **32-Bit Microcontroller**

The ARM7 microcontroller is a member of ARM family of 32 bit microprocessor which offers high performance at low power consumption.ARM architecture is based on the reduced instruction set computer RISC. It offers a high instruction throughput, a small and cost effective chip. It uses a three-stage pipeline to increase the speed of operation. ARM7TDMI has a feature of 16-bit Thumb instruction set, enabling high code density with a 32-bit performance level. It has two power saving modes ideal and power down.

- **Communication Module**

Zigbee is one of the global standard communication protocol based on IEEE 802.15.4 wireless personal area network. It is a specification for low power, low cost, long battery life, and low data rate device. This device specifies operation in the unlicensed 2.4GHz worldwide, 915MHz in America and Australia and 868MHz in Europe ISM band .In this we have used a pair of Zigbee module. One zigbee module is used as a coordinator and another is used as a router or end module. Zigbee pairing is done by using X-CTU software. Its Indoor/urban range up to 40m, outdoor /RF line of sight range up to 120m. Its RF data rate is 250kbps.

- **Sensor Unit**

Sensor unit consists of temperature and humidity sensors. Temperature sensor is directly calibrated in Celsius as it is based on the precision integrated circuit. Humidity sensor senses the relative humidity in the air. It is calibrated in %RH.

- **Backend Server**

The Backend server is a personal computer with graphical user interface (GUI).The GUI is design in VB.Net. Backend server performs the function of signal reception, visualization of measured parameter in graphical form and finally data is saved in the SQL database server for future purpose.

- **Interface Between PC And Zigbee Coordinator**

Zigbee coordinator module and GUI PC are connected via USB interface based on the IEEE1451.7 standard as shown in figure 2.USB PC provides a power to zigbee coordinator. As a result no need of external power for zigbee coordinator [6].

SOFTWARE DESIGN

Sensor node performs the function of collecting data and sending it to backend server. Firstly, it initializes all components and warm up sensor. Then it enters into the existing network. After receiving data from all sensors, it will process the received data and form a data packet, and then it enables the zigbee router and co-ordinator module for transmitting the data to the backend server.

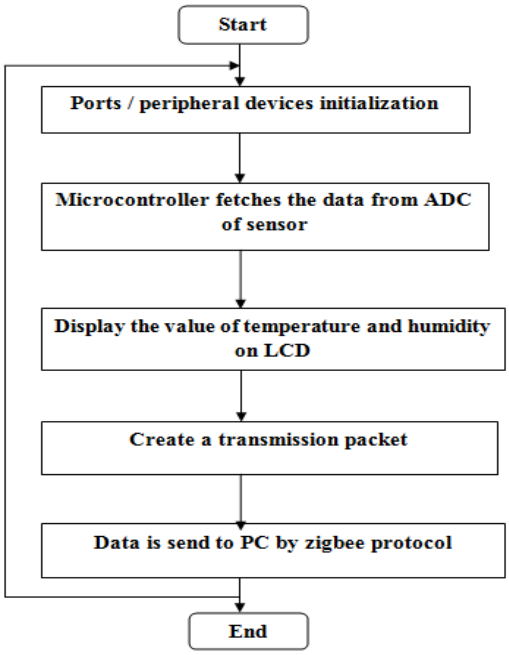

Figure 3: Flowchart of Sensor Node of Environment Monitoring System

RESULTS

The processed temperature and humidity values are displayed on the graphical user interface running on backend server. Graphical user interface is designed by VB.NET.It displayed both raw value and actual value of temperature and humidity. It also shows the condition of measured environmental parameter.

Figure 4

Table 1: Mesured Parameter Range

Environment	Temperature °C	Humidity %RH
Indoor	26.3-28.8	33.3-45.9
Outdoor	27.5-37.5	30-36.5

- Graph of measured Indoor and outdoor temperature at different time instant of a day.

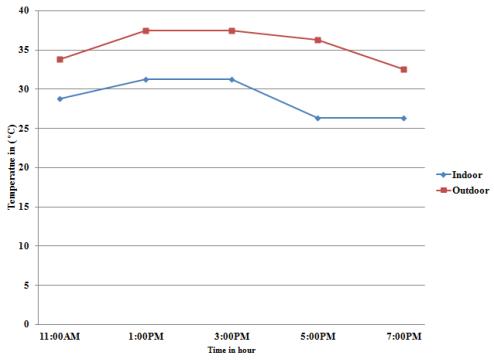

Figure 5

- Graph of measured indoor and outdoor humidity at different time instant of a day.

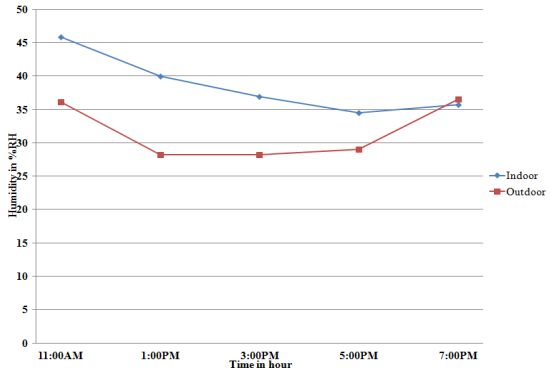

Figure 6

CONCULSIONS

This paper presents the energy efficient environment monitoring system with continuous real time data collection. This system consists of sensor node and backend server which is successfully developed. It also consists of database server for storage purpose so that it will be used for future purpose. The system is tested for monitoring the environmental parameter temperature and humidity in indoor and outdoor environment.

For further extend, the system can also be used for Greenhouse gases monitoring like CO2, CO, O3. DASH7 technology is used for long range communication which is useful for indoor application. Energy harvesting techniques is also useful in remote monitoring to increase the lifetime of system. The system is also useful for elder carrying, power management in buildings.

REFERENCES

1. *N. Kularatna and B. H. Sudantha, "An environmental air pollution monitoring system based on the IEEE 1451 standard for low cost requirements," IEEE Sensors J., vol. 8, pp. 415–422, Apr. 2008.*
2. *O. A. Postolache, J. M. D. Pereira, and P. M. B. S. Girao, "Smart sensors network for air quality monitoring applications," IEEE Trans. Instrum. Meas., vol. 58, no. 9, pp. 3253-3262, Sep. 2009.*
3. *A.R. Al-Ali, Member, IEEE, Imran Zualkernan, and Fadi Aloul, Senior Member, IEEE," A Mobile GPRS-Sensors Array for Air Pollution Monitoring" IEEE Sensor J., vol. 10, no. 10, Oct 2010.*

4. *Anuj Kumar, Hiesik Kim, and Gerhard P. Hancke, Senior Member, IEEE,'' Environmental Monitoring Systems: A Review ''IEEE Sensors Journal, Vol. 13, No. 4, April 2013.*
5. *Bartosz Pkosawski, Piotr Krasiski, Micha Siedlecki, Andrzej Napieralski,“ Autonomous Wireless Sensor Network for Greenhouse Environmental Conditions Monitoring” 20th International Conference "Mixed Design of Integrated Circuits and Systems", June 20-22, 2013, Gdynia, Poland*
6. *A Kumar, GP Hancke, “Energy efficient environment monitoring system based on the IEEE 802.15.4 standard for low cost requirements” Sensors Journal, IEEE, 2014.*
7. *Sherin Abraham, Xinrong Li, “A Cost-Effective Wireless Sensor Network System for Indoor Air Quality Monitoring Applications'' The 9th International Conference on Future Networks and Communications, 2014 Elsevier.*